Risk Factors Associated With Postoperative Complications Following Radical Cystectomy

(A Retrospective Cohort Study)

Master of Public Health Integrating Experience Project

Professional Publication Framework

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Abstract

Background: Bladder cancer is the most often occurring cancer in the urinary system. At the time of diagnosis, one third of cases are already muscle invasive requiring radical cystectomy with or without chemotherapy and radiation therapy. Radical cystectomy is associated with high rates of postoperative complications.

Objective: The aim of the study was to assess postoperative complications of radical cystectomy in Armenia and explore associated risk factors.

Methods: The study utilized a retrospective cohort design. Study population included all patients who have undergone radical cystectomy followed by either continent or conduit urinary diversion from 2005 to 2012 in all hospitals of Armenia. Detailed medical chart review was conducted extracting information on baseline demographic and clinical characteristics, surgical intervention, postoperative management and in-hospital complications.

Results: The total study sample included 273 patients with radical cystectomy. The mean age (sd) of the patients was 58.5(8.9) years and the majority (n=255, 93.4%) were men. Overall, 28.9% (n =79) of patients experienced at least one in-hospital complication. The hospital mortality rate was 4.8% (n =13). The most commonly reported complications were postoperative ileus (n = 20 or 7.3%), wound infection (n =19 or 7.0%), pyelonephritis (n = 13 or 4.8%), and wound dehiscence (n = 9 or 3.3%). Multiple logistic regression analysis revealed that coronary artery disease (OR=2.44, 95% CI: 1.20 – 4.96, p=0.01), receiving a transfusion (OR=2.40, 95% CI: 1.36 – 4.24, p<0.01) and hospital volume (OR=2.09, 95% CI: 1.03 – 4.24, p=0.04 for the second higher volume hospital compared to the highest volume) were the significant predictors of postoperative complications.

Conclusions: The rate of postoperative complications following radical cystectomy in Armenia was similar to those observed in other countries. Hospital volume, presence of coronary artery disease and receiving transfusion were significant predictors of complications. Future prospective studies should evaluate the long-term outcomes, costs of the complications as well as the appropriateness of perioperative transfusion. Hospitals should standardize and improve the management of high risk patients. National health policy decisions makers should consider the evidence from this study with respect to observed association between hospital volume and risk of complications.

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List of abbreviations

AIC – Akaike information criterion

ASA – American Society of Anesthesiologists

AUC – area under the curve

BMI – body mass index

CI – confidence interval

df – degree of freedom

DIC – disseminated intravascular coagulation

FFP – fresh frozen plasma

ICU – Intensive care unit

IRB – Institutional Review Board

LOS – length of stay

OR – odds ratio

RBC – red blood cells

ROC – receiver operating characteristic

SD – standard deviation

TUR – transurethral resection

Introduction

Bladder cancer is the most often occurring cancer in the urinary system (1). It was the ninth most common cancer worldwide in 2008, with 386,300 newly diagnosed cases (2). To compare, in 2002 the estimated number of new cases worldwide was 356,000 from which 274,000 cases were diagnosed in males and 83,000 in females (3). It was the 7th most often occurring cancer in males with an age standardized rate of 10.1 per 100,000, and 17thin females with a rate of 2.5 per 100,000 in 2002. For white men, the lifetime probability to have the disease is more than 4% or 1 of 25 men eventually will develop a bladder cancer (3). In white women, the lifetime probability is 1.2% or 1 in 80 (3). The incidence rate of bladder cancer has a 10-fold variation among countries (1).

Considering the increasing burden of bladder cancer it is very important to understand the disease epidemiology. A systematic review reported that established risk factors of developing bladder cancer include smoking, aging, occupational exposure to aromatic amines, genetic predisposition, urinary tract diseases, urinary shistosomiasis, diet, exposure to certain microelements through drinking water, intake of some drugs, and tea, coffee, and alcohol consumption (1). Smoking is the most important risk factor of bladder cancer with established 2-3 times increased risk of incidence among ever smokers compared to nonsmokers (1). In 2008, it was estimated that smoking caused 34% of bladder cancer deaths among men and 13% among women in the world (2). Furthermore, the prevalence of smoking continues to increase in low- and middle-income countries while it is on decline in high-income countries (3). Compared to 1998, in 2008 the use of tobacco was increased by 16.1%, 8.7%, and 6.5% in Africa/Middle East, Eastern Europe/former Soviet Union, and Asia/Australia, respectively (3). Aging is another established risk factor contributing to development of bladder cancer (3). In 2050, the

world population is expected to increase by 2.5 billion people, half of the increase contributed by aging population (3). It is expected that the incidence of bladder cancer will continue to increase in the future in low- and middle-income countries due to increasing prevalence of the risk factors (3).

It has been reported that at the time of the diagnosis 30% of bladder cancers are already muscle invasive (4) for which the treatment includes surgery and/or chemotherapy and/or radiation therapy (5). Currently, radical cystectomy with extended lymph node dissection remains a gold standard for local control of muscle invasive bladder cancer (5). Radical cystectomy is a difficult surgery simultaneously done on urinary tract, intestines, and lymph nodes. The difficulty of the procedure is also associated with the type of urinary diversion (6). The surgery has a high incidence of both early and late complications (7). In various studies, the reported rate of surgical complications ranged from 25.7% to 64.0% (8-12). In a review of 23 studies conducted between 1999 and 2009 describing and evaluating the complications after radical cystectomy, the most reported complications included paralytic subileus (0 – 22.7%), gastrointestinal including emesis, gastritis, and ulcer (0 – 16.1%), wound infection (0 – 15.0%), cardiac diseases including myocardial infarction, dysrhythmia, cardiac arrest (0 -13.0%), urinary tract infections (0 – 12.8%), constipation (0 – 12.0%), wound dehiscence (0 – 9.0%), septicemia (0 – 9.0%), postoperative hemorrhage, transfusion of more than four units within 72 hours after the surgery (0 – 9.0%), enteroanastamosis leak (0 – 8.7%), enterocolitis/persistent diarrhea (0 – 8.0%), pneumonia (0 – 7.8%), pyelonephritis (0 – 7.4%), small bowel obstruction (0 – 7.0%), acute renal failure requiring dialysis or ultrafiltration (0 – 7.0%), and deep vein thrombosis (0 – 5.3%) (13). Other studies reported that the rates of infectious complications range from 24.4% to

25.0% (7,8,12), genitourinary from 11.0% to 16.8% (8,12), gastrointestinal from 14.8% to 29.0%(7,8,12) and wound related from 8.5% to 15.0% (7,8,12).

The framework for assessing postoperative complications of surgeries within the Department of Veterans Affairs National Surgical Quality Improvement Initiative consists of 'preoperative risk factors', 'structure of care', 'process of care' and 'outcomes' domains (9). There are many potentially modifiable and non-modifiable risk factors that can affect the rate of complications following cystectomy. The potential risk factors for developing complications can be classified into three groups (4,12-16). The first group, ***preoperative factors***, include demographic factors (e.g., age, gender, BMI, smoking), co-morbid conditions (e.g., diabetes, renal failure, chronic obstructive pulmonary disease, gastro-intestinal disease, cardiovascular diseases), as well as cancer stage, prior surgeries, prior cancer treatment, type of the urinary diversion and American Society of Anesthesiologists (ASA) score (4,12-16). The second group, ***operative factors***, include time of the surgery, blood loss, transfusion data, surgeon experience, type of anesthesia, extubation (4,12-14,16). The third group, ***postoperative factors***, consists of length of intensive care unit stay, gastric tube removal, intestinal stimulation, stent removal, and length of stay (4,12-16).

Postoperative complications from radical cystectomy are associated with longer length of hospital stay (LOS), increased costs of care, and higher risk of in-hospital mortality (11). Therefore, predicting complications and minimizing the probability of their occurrence is very important.

According to the National Information Analytic Centre of Armenia, in 2011 in Armenia the estimated incidence rate of bladder cancer was 23.9 per 100,000 among men with 379 new diagnosed cases and 1.8 per 100,000 among women with 31 new cases (17). In 2011, the

prevalence rate of bladder cancer was 54.1 per 100,000 (17). To the best of our knowledge, no prior study investigated complications following radical cystectomy in Armenia. Therefore, understanding the risk factors associated with the complications is very important and would help to guide strategizes that can improve patient care and outcomes.

Aims and research questions

The aim of the study was to assess the postoperative complications of radical cystectomy in Armenia and investigate potential risk factors of these complications. The specific objectives of the study were:

- To estimate the incidence of complications following radical cystectomy in hospitals of Armenia
- To evaluate the potential effects of demographic, behavioral and operative characteristics on postoperative complications following radical cystectomy
- To develop recommendations to improve patient care

The research questions of the study were:

- What is the incidence of complications following radical cystectomy in Armenian hospitals?
- What risk factors were associated with the complications following radical cystectomy?

Methods

Study design

The study utilized a retrospective cohort design enrolling all patients who have undergone radical cystectomy (followed by continent or conduit urinary diversion) in all hospitals of Armenia from 2005-2012. Taking into consideration that no hospitals in rural areas perform this type of surgery, the study accounted for all surgeries conducted in Yerevan hospitals. Patients were followed from the day of hospital admission to the day of discharge or death whichever occurred first during the index hospitalization. The rationale for choosing all hospitals was to ensure that the sample was large enough to obtain precise estimates and to have a representative sample for the population of Armenia. For the study purposes, medical records of all identified patients were retrieved and reviewed.

Study population

The target population for the study included patients with radical cystectomy for bladder cancer. Study population included all patients who have undergone radical cystectomy followed by either continent or conduit urinary diversion from 2005 to 2012 in all hospitals of Armenia. Patients who have received bilateral ureterocutaneostomy and/or those with missing medical records were excluded.

Sample size

Sample size was calculated based on intraoperative transfusion as the primary exposure of interest. Hollenbeck et al reported that in 2,538 radical cystectomy consecutive cases the observed complication rate was 37.6% in patients with intraoperative transfusion and 22.8% in

patients without transfusion (9). Considering 95% confidence interval, 80% power and a ratio of 70:30 (without transfusion: with transfusion), the required sample size was 380 patients in total (see Appendix 1for details). At the time of study planning it was not clear if the desired sample size would be feasible, and a decision was made to include all patients who had radical cystectomy between 2005 and 2012 in all eligible hospitals of Armenia. The timeframe was limited to seven years to minimize the impact of potential clinical practice or health policy changes on observed outcomes.

Study instrument

The student-investigator developed a data abstraction form to extract the information from medical records of the patients, after conducting a detailed review of relevant literature and consulting local experts. Information on patient demographic characteristics, comorbidities, preoperative laboratory analysis, operative variables, postoperative factors, and complications after radical cystectomy were extracted from medical records (Appendix 2). Data abstraction form has been pre-tested using the medical records of 10 patients with the same eligibility criteria who had surgery in 2013 and who were not part of this study. Based on the pre-test results some minor changes have been introduced.

Data collection

Medical chart review and data abstraction was conducted during March-April, 2013. First, all Yerevan hospitals that had urological departments and had a potential capacity of performing radical cystectomy were selected. Once it was established that this type of the surgery is performed in the hospital, permission to access patient data was sought from the

hospital administration. Next, the complete list of patients was obtained from the urological department of the hospital, and the medical records of patients meeting the eligibility criteria were reviewed.

Study variables

The dependent variable (outcome) for the current study was the presence or absence of complications after radical cystectomy as defined in the medical records. Main independent variables included age, gender, body mass index (BMI), smoking status, presence or absence of comorbid factors, type of urinary diversion, American Society of Anesthesiologists (ASA) score, intraoperative blood loss, operative time, presence or absence of transfusion, previous surgery, length of stay (LOS) at the intensive care unit (ICU). Appendix 3 presents the details of the study variables.

Statistical analysis

After chart abstraction data were entered into an SPSS 17.0 database (SPSS Inc. Released 2008. SPSS Statistics for Windows, Version 17.0. Chicago: SPSS Inc.). All statistical analyses were performed using SPSS 17.0 database and Stata 10 statistical software (StataCorp. 2007. Stata Statistical Software: Release 10. College Station, TX: StataCorp LP). Data cleaning was conducted through range checking and logical checking. Continuous variables were described using means and standard deviations, and categorical variables were described using frequencies and percentages. Independent t-test or Fisher's exact test was used to compare continuous variables and chi square test to compare categorical variables. Loess smooth curves were used to investigate the relationship between the dependent variable and continuous variables and to

decide on the appropriate cut-point, when applicable. Multiple logistic regression analysis was used to estimate the independent risk factors of developing any postoperative complication, after investigating for potential interactions and confounders. First, candidate variables for the model were selected based on the current literature and results from the univariate logistic regression analysis. Next, variables were added to the model one at a time and tested using the Log-likelihood Ratio test and Akaike information criterion (AIC). Model fit was tested by the Hosmer-Lemeshow goodness-of-fit test and area under the receiver operating characteristic (ROC) curve. Any variable with more than 10% missing values were excluded from the regression analysis. All results with the p value less than 0.05 were considered as statistically significant.

Ethical considerations

Institutional Review Board/Committee on Human Research (IRB) within the College of Health Sciences at the American University of Armenia approved the study. In addition, permissions have been received from the heads of the hospitals to access medical records and conduct the study. No personal identifiers (such as name of the patient, phone number, address) were abstracted from the medical records. Paper data abstraction forms were archived after data entry. The electronic data remained secure and only the student-investigator and the principal investigator had access to data.

Results

Eight hospitals were identified to perform radical cystectomy in Yerevan and in Armenia. Only one medical center performing 1-2 surgeries per year refused to participate. The medical

records of all patients who had surgery between 2005 and 2012 in the participating hospitals were available for review. The total number of patients who had radical cystectomy with either continent or conduit urinary diversion between 2005 and 2012 in 7 hospitals of Armenia was 273. As the number of cases in four hospitals was low (less than 10 in each), it was decided to combine them into one group (hospital D in the analysis).

Table 1 represents patient baseline and operative characteristics. The mean age (standard deviation (sd)) of the patients was 58.5(8.9) years and the majority (n=255, 93.4%) were men. Approximately 77.0% of patients lived in cities and 43.2% were from Yerevan. The mean BMI (sd) was 26.0 (4.6). In 56.8% of cases cancer was confined to bladder. About 74.0% of patients were current smokers, 24.5% had preoperative hydronephrosis, 15.8% had coronary artery disease, 5.1% had diabetes, and 19.0% had hypertension. As for type of surgery, 85.7% have had continent urinary diversion and 14.3% conduit urinary diversion. The mean duration of the surgery was 326 minutes ranging from 150 to 660 minutes. The mean (sd) ICU length of stay (LOS) after the surgery was 2.4 days (1.0) and the mean hospital (sd) LOS was 35.7 (18.3) days.

In-hospital complications

In total, 110 in-hospital postoperative complications occurred in 79 patients (Table 2) representing 28.9% of the total sample. Among patients with complications, 54 (19.8%) had one complication, 20 (7.3%) had two and 5 (1.9%) patients had three or more. In-hospital mortality rate was 4.8% (13/273), and all patients that died developed some type of complication before that. The most commonly occurred complications were postoperative ileus (20/273 or 7.3%), wound infection (19/273 or 7.0%), pyelonephritis (13/273 or 4.8%), and wound dehiscence

(9/273 or 3.3%). No variations were observed in the type and rate of complications across the years of performed surgeries.

Univariable risk factors of complications

Results from univariable logistic regression analysis are presented in Table 3. There was a statistically significant difference in the rate of the complications between different hospitals. The probability of developing postoperative complications was 2.21 times higher (p=0.02, 95% CI: 1.13 – 4.33) in hospital B and 2.48 times higher (p=0.07, 95% CI: 0.92 – 6.68) in hospital D compared to hospital A which had the largest volume (n = 172) and was selected as a referent category. Presence of coronary artery disease (CAD) was also associated with the increased probability of developing complication (OR=2.51; 95% CI: 1.28 – 4.89, p<0.01). There were more complications among the patients with higher ASA score (OR=2.12; 95% CI: 1.18 – 3.80, p=0.01) as well as in patients who have received intraoperative and/or postoperative transfusion of fresh frozen plasma and/or red blood cells (OR=2.80; 95% CI: 1.63 – 4.79, p<0.01). Patients with preoperative blood glucose level higher than 5 mmol/l were 0.48 times less likely to develop postoperative complications (OR=0.48, 95% CI: 0.28-0.83, p<0.01). In addition, patients who have experienced one or more complications had longer preoperative LOS (OR=1.06; 95% CI: 1.02 – 1.09, p<0.01) and longer postoperative (OR=1.06: 95% CI: 1.04 – 1.08, p<0.01) LOS.

Adjusted analysis of risk factors

Multiple regression analysis was performed to find the independent risk factors of postoperative complications following radical cystectomy. The final model included the hospital

where the surgery was performed, CAD and operative and postoperative transfusion of fresh frozen plasma and/or red blood cells. No significant interactions were observed. The model had acceptable calibration and discrimination (Hosmer - Lemeshow goodness-of-fit test statistics = 8.69, p=0.12 and C-statistic=0.6718, respectively). Detailed analyses are presented in Appendix 4.

According to the final model, after adjusting for transfusion and hospital, patients with CAD had 2.4 times (95% CI: 1.20 – 4.96, p=0.01) higher risk for developing postoperative complications compared to those without. Receiving a transfusion increased the risk of developing complications by 2.4 times (95% CI: 1.36 – 4.24, p<0.01). Compared to Hospital A, patients in Hospital B had 2.1 times (95% CI: 1.03 – 4.24, p=0.04) higher risk of developing complications.

Discussion

The study investigated the associations between different preoperative, operative, and postoperative risk factors and the probability of developing postoperative complications among patients who have undergone radical cystectomy. To our knowledge this was the first study conducted in Armenia that included all patients who had radical cystectomy over the last seven years.

Our study population was not very different from those described in the literature by other studies (9,18). The rate of postoperative complications in all hospitals of Armenia was 28.9%, which was similar to the findings from previous studies (8-12). Furthermore, the most frequent types of complications observed in our study were postoperative ileus (7.3%), wound infection (7%), urinary tract infection (4.8%), and wound dehiscence (3.3%) which were similar

to observations from other studies (8,9,12,13,15,16,19-21). Postoperative mortality rate was 4.8% in our sample, higher than the rates described in past studies where it varied from 1.5% to 3.7% (8,22-24).

The observed association between the transfusion and development of postoperative complications was consistent with the results of past studies (9,12). In our study, the transfusion variable included both intraoperative and postoperative transfusions of both red blood cells and fresh frozen plasma and increased the risk of complications 2.4 times. The study by Hollenbeck et al that included 2,538 patients reported that the intraoperative transfusion increased the risk of complications by 1.4 times (9). Another study of 1,142 consecutive radical cystectomy patients also indicated increased risk of developing complications associated with transfusion. However, in the risk was increased in those patients who have received more than four packs of both red blood cells or fresh frozen plasma (12).

In our study we found that patients with CAD are at higher risk of developing postoperative complications. The result was consistent with the past studies (11,20). Previous studies also identified chronic pulmonary disease, diabetes, hypertension, weight loss, and fluid and electrolyte disorders to be significant predictors of postoperative complications (11,20). Unlike these larger sample size studies we did not observe similar associations. Moreover, we did not find a significant association between age, BMI and complications which was also observed in several past studies (9,12,16,20).

Several studies in the past reported a positive association between the ASA score (indicator of operative risk) and development of postoperative complications (9,12,16). In our univariable analysis ASA score was also statistically significantly associated with the increased risk of postoperative complications. However, it was no more significant in multivariable analysis.

Our study revealed that the mean days of hospital stay of patients with postoperative complications was significantly higher in comparison to patients without complications (34.8 versus 23.2 days respectively), ultimately increasing treatment costs as well. A US population-based study that enrolled 6,577 patients from 1998 to 2002, reported that the median LOS for patients without complication was 9 days compared to 13 days for patients with complications (10). Each complication increased the LOS greatly and, in the case of multiple complications, a cumulative effect was observed. In terms of costs, each complication increased the expenditures by 35%, and the greatest expenditures were noticed in patients who have developed more than three complications. The study suggested that the decrease in the primary complication rate after cystectomy would lead to decreased cost of care and better outcomes (10). Comparing to this study, the hospital length of stay of patients in our sample was much longer which could be explained by several factors such as cost of care (each day in a US hospital is much higher than in Armenia), health care service structure (more developed outpatient services in the US than in Armenia, especially if Armenian patients come to the capital city from rural regions for a surgery), and, finally overall patient management.

Finally, we found that hospital volume was another important predictor of developing complications after the surgery – the hospital performing the highest number of surgeries had significantly fewer patients with complications. Similarly, past studies showed lower rate of complications and subsequently lower in-hospital mortality in higher volume centers (20,25). Surgeon experience was also found to be positively associated with postoperative complications following a radical cystectomy (5,9).

The standardized approach to data collection is one of the strengths of the study. The student – investigator pre-tested the data collection tool and then abstracted data from all medical

records. Another strength was the inclusion of almost all hospitals in Armenia that perform radical cystectomy and conducting a census of the targeted patient population. The post-hoc analysis demonstrated that the actual power of the study was very high (0.98).

The study results, however, should be interpreted under the light of some limitations. There was variability between the hospitals in the way patient medical history was gathered and clinical information was recorded. To minimize the potential effect of this variability, standardized measuring parameters and variable definitions were used. Some of the variables of interest had high missing rate such as smoking history. To avoid bias, any variable with more than 10% missing values were excluded from the final analysis. Another source of bias might be associated with the length of time period for which the medical records were abstracted. During study period some changes might have occurred in the hospitals resulting in changes of patient care. However, we did not observe variation in complication types and rates across these seven years. Another important limitation was that patients were from seven different hospitals. Although this increased the external validity of the findings, it might have also introduced differences in patient care processes and outcomes. We believe that the impact of this limitation was not significant since the majority of patients were treated in one hospital. Finally, as the information was collected retrospectively, it was impossible to evaluate the appropriateness of indications for transfusion.

Conclusions and recommendations

The study findings suggest that the postoperative complication rates after radical cystectomy in Armenia were similar to those observed in past studies and other countries. Hospital volume, presence of coronary artery diseases and receiving transfusion are significant

and independent predictors of postoperative complications. Future prospective studies should evaluate the long-term outcomes and costs of the complications as well as the appropriateness of perioperative transfusion.

Based on the results of current study the following recommendations are made:

- The indications for intraoperative and postoperative transfusions of RBC and FFP should be more carefully considered. Doctors should be encouraged to follow current guidelines to minimize the complications associated with the transfusion.
- Patients with coronary artery disease who undergo radical cystectomy should be considered as high-risk patients. Local or national treatment protocols should be developed to standardize and improve perioperative care of these patients.
- National health policy decisions makers should consider the evidence from this study with respect to observed association between hospital volume and risk of complications. Radical cystectomy should be performed by high-volume centers and more experienced surgeons. Low-volume hospital should consider providing additional training to their doctors and developing standardized protocols to improve patient care processes and outcomes.

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Table 1. Patient characteristics

Characteristics	n = 273
Age (years), mean ± sd	58.5 ± 8.9
Male, n (%)	255(93.4)
Place of living, n (%)	
Urban	210(76.9)
Rural	63(23.1)
No in each hospital (%)	
A	172(63.0)
B	48(17.6)
C	34(12.5)
D	19(7.0)
Year of surgery, n (%)	
2011/12	57(20.9)
2009/10	86(31.5)
2007/08	81(29.7)
2005/06	49(17.9)
BMI (kg/m^2), mean ± sd	26 ± 4.6
Current smoker, n (%)*	133(73.9)
Diabetes, n (%)	14(5.1)
Hypertension, n (%)	52(19.0)
Preoperative hydronephrosis, n (%)	67(24.5)
Preoperative chemotherapy, n (%)	22(8.1)
Any allergy, n (%)	18(6.6)
Any prior surgery, n (%)	104(38.1)
Urological diseases, n (%)	46(16.8)
Gastrointestinal diseases, n (%)	55(20.1)
Coronary artery disease, n (%)	43(15.8)
Respiratory diseases, n (%)	21(7.7)
Other diseases, n (%)	50(18.3)
Other cancer, n (%)	4(1.5)
Hemoglobin level (g/l), mean ± sd	134.1 ± 18.7
Preoperative red blood cells count ($x10^{12}/L$), mean ± sd	4.15 ± 0.6
Preoperative white blood cells count ($x10^{9}/L$), mean ± sd	7.48 ± 2.1
Preoperative glucose level (mmol/l), mean ± sd	5.7 ± 1.9
Preoperative protein level (g/100ml), mean ± sd	7.8 ± 0.6
Preoperative creatinin level (mkm/L), mean ± sd	90.7 ± 24.8
Preoperative fibrinogen (mg/100ml), mean ± sd	430.2 ± 120.6
Transurethral resection (TUR) in the past, n (%)	123(45.1)
Preoperative cystoscopy, n (%)	76(27.8)
Preoperative TUR biopsy, n (%)	60(22.0)
Stage of the cancer, n (%)	
Bladder confined (pT1-2 pN0 M0)	155(56.8)
Locally Advanced (pT3-4 pN0 M0)	86(31.5)
Extravesical (pT2-4N>0M0)	32(11.7)
Type of urinary diversion, n (%)	
Continent	234(85.7)
Conduit	39(14.3)
ASA score, n (%) *	

1 or 2	180(71.7)
3 or 4	70(28.3)
Anesthesia type, (%)	
General	38(13.9)
Combined general and epidural	235(86.1)
Operative time (minutes), mean ± sd	325.6 ± 81.5
Intraoperative and/or postoperative transfusion of RBC, n (%)	80(29.3)
Intraoperative and/or postoperative transfusion of FFP, n (%)	55(20.1)
Intraoperative and/or postoperative transfusion (RBC and/or FFP), n (%)	107(39.2)
Preoperative LOS (days), mean ± sd	9.3 ± 8.4
ICU LOS (days), mean ± sd	2.38 ± 1.0
Postoperative LOS (days), mean ± sd	26.5 ± 14.3
Total LOS (days), mean ± sd	35.7 ± 18.3

** 34.1% and 8.1% were missing for the variables "Current smoker" and "ASA", respectively.*
For these variables percentages were calculated after excluding missing values.
ASA=American Society of Anesthesilogists; BMI = body mass index; ICU=intensive care unit; FFP = fresh frozen plasma; LOS = length of stay; RBC = red blood cells; sd = standard deviation; TUR = transurethral resection

Table 2: Postoperative in-hospital complications (n = 273)

Complications	n (%)
No complication	194(71.1)
Postoperative ileus	20(7.3)
Wound infection	19(7.0)
Urinary tract infection	13(4.8)
Dehiscence	9(3.3)
Postoperative pneumonia	6(2.2)
Congestive heart failure	6(2.2)
Postoperative hemorrhage	5(1.8)
Myocardial infarction	4(1.5)
Pulmonary artery thrombosis	4(1.5)
Peritonitis	4(1.5)
Deep venous thrombosis	3(1.1)
Lymphocele	3(1.1)
Insufficiency of anastomosis of small bowel	3(1.1)
Postoperative acute renal failure	3(1.1)
Postoperative sepsis	2(0.7)
Bowel perforation	2(0.7)
Ischemic stroke	1(0.3)
Urinary leak	1(0.3)
Arrhythmia	1(0.3)
Disseminated intravascular coagulation	1(0.3)

Table 3: Simple logistic regression analysis of postoperative complications

Characteristics	Unadjusted OR (95% CI)	P Value
Age	1.00(0.97-1.03)	0.83
Female gender	0.47(0.13-1.67)	0.24
Rural place of living	1.01(0.98-1.04)	0.54
Hospitals		
A	1.00	
B	2.21(1.13-4.33)	0.02
C	1.11(0.48-2.57)	0.8
D	2.48(0.92-6.68)	0.07
Year of surgery		
2011/12	1.00	
2009/10	1.09(0.62-1.90)	0.77
2007/08	0.75(0.42-1.36)	0.34
2005/06	0.86(0.43-1.72)	0.67
BMI	1.01(0.95-1.07)	0.73
Diabetes	1.38(0.45-4.26)	0.57
Hypertension	1.02(0.52-2.00)	0.95
Preoperative hydronephrosis	1.05(0.91-1.21)	0.50
Preoperative chemotherapy	1.44(0.58-3.58)	0.43
Any allergy	0.96(0.78-1.18)	0.71
Any prior surgery	0.86(0.50-1.49)	0.60
Urological diseases	1.27(0.64-2.52)	0.48
Gastrointestinal diseases	0.80(0.41-1.57)	0.51
Coronary artery disease	2.51(1.28-4.89)	<0.01
Respiratory diseases	0.98(0.36-2.61)	0.96
Other diseases	0.97(0.49-1.93)	0.94
Other cancer	2.48(0.34-17.93)	0.37
Hemoglobin level	1.01(0.99-1.02)	0.44
Preoperative red blood cells count	1.25(0.77-2.02)	0.36
Preoperative white blood cells count	1.04(0.92-1.18)	0.49
Preoperative glucose level >5 mmol/L	0.48(0.28-0.83)	<0.01
Preoperative protein level	1.00(0.63-1.58)	0.99
Preoperative creatinin level	1.01(1.00-1.02)	0.19
Preoperative fibrinogen	1.00	0.88
Transurethral resection (TUR) in the past	0.82(0.48-1.39)	0.47
Preoperative cystoscopy	0.98(0.90-1.07)	0.66
Preoperative TUR biopsy	0.98(0.88-1.08)	0.65
Conduit type of urinary diversion	0.82(0.38-1.77)	0.61
ASA score 3 and 4	2.12(1.18-3.80)	0.01
Combined general and epidural anesthesia	0.51(0.25-1.03)	0.06
Operative time	1.00	0.36
Intraoperative and postoperative transfusion (RBC and FFP)	2.80(1.63-4.79)	<0.01
ICU LOS	0.99(0.76-1.29)	0.94

ASA=American Society of Anesthesilogist; BMI = body mass index; ICU=intensive care unit; FFP = fresh frozen plasma; LOS = length of stay; RBC = red blood cells; TUR = transurethral resection

Table 4: Multiple logistic regression analysis of postoperative complications (final model)

Characteristics	Without complications (n)	With complications (n)	Odds Ratio (95%CI)	P Value
Hospital				
Hospital A	132	40	1.00	
Hospital B	25	23	2.09(1.03 – 4.24)	0.04
Hospital C	27	6	1.26(0.52 – 3.06)	0.60
Hospital D	9	10	1.79(0.63 – 5.10)	0.27
CAD				
No	171	59	1.00	
Yes	23	20	2.44(1.20 – 4.96)	0.01
Transfusion				
No	131	34	1.00	
Yes	62	45	2.4(1.36 – 5.43)	<0.01

CAD= coronary artery disease

Appendix 1: Sample size calculation

EpiInfo Version 6 Statcalc November 1993

Unmatched Cohort and Cross-Sectional Studies (Exposed and Nonexposed)

Sample Sizes for 22.80 % Disease in Unexposed Group

			Disease	Risk	Odds	Sample Size		
Conf.	Power	Unex:Exp	in Exposed	Ratio	Ratio	Unexp.	Exposed	Total
95.00 %	80.00 %	70:30	37.60 %	1.65	2.04	266	114	380

Appendix 2: Medical Record Data Abstraction Form

Administrative Data		
1. Patient ID _____		**2.** Hospital ID_____
3. Date of hospital admission ___/___/_____	**4.** Date of surgery ___/___/_____	**5.** Date of discharge ___/___/_____
Demographic data		
6. Date of birth ___/___/_____ or age ___(only if date of birth is missing)		
7. Gender 1.☐ Male 2.☐Female 99.☐ Unclear/missing		
8. Height (cm) _____		
9. Weight (kg) _____		
10. Marital status	1.☐ Single 2.☐ Married 3.☐ Divorced 4.☐ Widowed 99.☐ Unclear/missing data	
11. Place of residence (Marz)	1.☐ Yerevan 2.☐Kotayq 3.☐Tavush 4.☐ Lori 5.☐Gegharquniq 6.☐VayotsDzor	

	7.☐Syuniq 8.☐ Ararat 9.☐Armavir 10.☐Aragatsotn 11.☐Shirak 12.☐Karabach 99.☐ Unclear/missing data
12. Place of living	1.☐ City 2.☐ Village 99.☐ Unclear/missing
13. Current smoker	0.☐ No 1.☐Yes 99.☐ Unclear/missing
14. Former smoker	0.☐ No 1.☐Yes 99.☐ Unclear/missing
15. Presence of allergy	0.☐ No 1.☐Yes 99.☐ Unclear/missing
16. Duration of the disease (years) _____ (first symptom seen/felt as per patient report)	
17. Year of the first symptom _____	
18. First symptom seen by patient _____	
Comorbidities	
19. Diabetes	0.☐ No 1.☐Yes 99.☐ Unclear/missing
20. Hypertension (diagnosed/defined by the admitting doctor)	0.☐ No 1.☐Yes 99.☐ Unclear/missing
21. Preoperative hydronephrosis (revealed by CT or sonography)	0.☐ No 1.☐Yes 99.☐ Unclear/missing
21a. If yes → which side?	1.☐ Unilateral left

	2.☐ Unilateral right 3.☐ Bilateral
22. Acute preoperative renal failure	0.☐ No 1.☐Yes 99.☐ Unclear/missing
23. Preoperative dialysis	0.☐ No 1.☐Yes 99.☐ Unclear/missing
24. Preoperative chemotherapy	0.☐ No 1.☐Yes 99.☐ Unclear/missing
25. Preoperative radiotherapy	0.☐ No 1.☐Yes 99.☐ Unclear/missing
26. Undergone surgeries in the past **26a.**If yes, specify → _____	0.☐ No 1.☐Yes 99.☐ Unclear/missing
27. Diseases in the past **27a.**If yes, specify → _____	0.☐ No 1.☐Yes 99.☐ Unclear/missing
28. History of cerebrovascular diseases (stroke, TIA)	0.☐ No 1.☐Yes 99.☐ Unclear/missing
29. Urological diseases **29a.**If yes, specify → _____	0.☐ No 1.☐Yes 99.☐ Unclear/missing
30. Gastrointestinal diseases **30a**. If yes, specify → _____	0.☐ No 1.☐Yes 99.☐ Unclear/missing
31. Cardiac diseases **31a.** If yes, specify → _____	0.☐ No 1.☐Yes 99.☐ Unclear/missing
32. Respiratory diseases **32a.** If yes, specify → _____	0.☐ No 1.☐Yes 99.☐ Unclear/missing
33. Other cancer **33a.** If yes, specify → _____	0.☐ No 1.☐Yes 99.☐ Unclear/missing
34. Gynecological diseases	0.☐ No 1.☐Yes 99.☐ Unclear/missing

34a. If yes, specify → _____
35. Other diseases 0.☐ No 1.☐Yes 99.☐ Unclear/missing **35a.** If yes, specify →_____
Laboratory analysis *(In the cases of multiple analyses the measurements from the last analysis closest to the surgery will be taken into consideration)*
36. Blood group 0.☐ I 1.☐II 2.☐III 1.☐IV 99.☐ Unclear/missing
37. Rhesus factor 0.☐ Negative 1.☐Positive 99.☐ Unclear/missing
38. Preoperative Hb(g/l) _____
39. Preoperative red blood cells count (x 10^{12}/L) _____
40. White blood count (x 10^{9}/L) _____
41. Platelets (x 10^{9}/L) _____
42. Glucose level (mmol/L) _____
43. Preoperative total protein level (g/100ml) _____
44. Preoperative total bilirubin level (mkm/l) _____
45. Preoperative creatinine level (mkm/l) _____
46. Preoperative fibrinogen (mg/100ml) _____
47. Preoperative serum potassium mmol/L _____
48. Preoperative serum sodium mmol/L _____
49. Hematuria 0.☐ No 1.☐Yes 99.☐ Unclear/missing
50. Piuria 0.☐ No 1.☐Yes 99.☐ Unclear/missing
51. Other changes in urine analysis 0.☐ No 1.☐Yes 99.☐ Unclear/missing **51a.** If yes, specify → _____
52. Transurethral resection (TUR) in the past 0.☐ No 1.☐Yes 99.☐ Unclear/missing

52a. If yes → When was it performed?	1.☐< 1 year before radical cystectomy 2.☐ 1-2 before radical cystectomy 3.☐> 2 years before radical cystectomy
53. Preoperative cystoscopy	0.☐ No 1.☐Yes 99.☐ Unclear/missing
54. Preoperative TUR biopsy of the tumor **54a.** If yes → What does it reveal? _____	0.☐ No 1.☐Yes 99.☐ Unclear/missing
55. Stage of the cancer (from the pathological examination report)	1.☐ pT1N0M0 2.☐ pT2aN0M0 3.☐ pT2bN0M0 4.☐ pT3N0M0 5.☐ pT4N0M0 6.☐ pT2-4N1M0
Operative variables	
56. Type of the urinary diversion	1.☐ Continent 2.☐ Conduit 99.☐ Unclear/missing
57. ASA score (American Society of Anesthesiologists)	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 99.☐ Unclear/missing
58. Anesthesia type	1.☐ Spinal/epidural 2.☐ General 3.☐ Both 99.☐ Unclear/missing
59. Operative time (hrs)_____	

(from the start till the end of surgery (not anesthesia))

60. Blood loss (ml)_____

61. Intraoperative transfusion 0.☐ No 1.☐Yes 99.☐ Unclear/missing

(red blood cell (RBC))

61a. If yes → Total RBC transfused during the surgery (ml) _____

62. Intraoperative transfusion 0.☐ No 1.☐Yes 99.☐ Unclear/missing

(other than RBC)

If yes → 62***a.*** What was transfused _____

62 b. How much in total was transfused (ml) _____

63. The extent of lymphadenectomy 1.☐Limited

2.☐ Standard

3.☐ Till the bifurcation of the aorta

4.☐ Extended

99.☐ Unclear/missing

64. Number of removed lymph nodes _____ 99.☐ Unclear/missing

65. Number of removed positive lymph nodes (through pathological examination) _____

66. Invasion of the lymphatic system 0.☐ No 1.☐Yes 99.☐ Unclear/missing

(through pathological examination)

66a. If yes → Invasion side 1.☐ Unilateral 2.☐ Bilateral

Postoperative factors

67. Postoperative transfusion 0.☐ No 1.☐Yes 99.☐ Unclear/missing

(red blood cell (RBC))

67a. If yes → Total RBC transfused after the surgery (ml) _____

68. Postoperative transfusion (other than RBC) If yes → 68***a.*** What was transfused _____ ***68b.*** How much in total was transfused (ml) _____	0.☐ No 1.☐Yes 99.☐ Unclear/missing
69. Length of stay at Intensive Care Unit (ICU) (days) _____	
70. Length of ureteral catheterization (days) _____ **71.** Length of urethral catheterization (days) _____	
72. Bowel stimulation	0.☐ No 1.☐Yes 99.☐ Unclear/missing
Complications after radical cystectomy	
73. Any postoperative complication ***If No, stop here.***	0.☐ No 1.☐Yes
74. Postoperative ileus	0.☐ No 1.☐Yes
75. Urinary tract infection	0.☐ No 1.☐Yes
76. Postoperative sepsis	0.☐ No 1.☐Yes
77. Wound infection	0.☐ No 1.☐Yes
78. Postoperative acute renal failure	0.☐ No 1.☐Yes
79. Ureteral obstruction	0.☐ No 1.☐Yes
80. Urinary leak	0.☐ No 1.☐Yes
81. Arrhythmia	0.☐ No 1.☐Yes
82. Postoperative myocardial infarction	0.☐ No 1.☐Yes
83. Postoperative pneumonia	0.☐ No 1.☐Yes
84. Deep venous thrombosis	0.☐ No 1.☐Yes
85. Dehiscence	0.☐ No 1.☐Yes

86. Postoperative hemorrhage	0.☐ No 1.☐Yes
87. Other complications **88a.**If yes → specify _____	0.☐ No 1.☐Yes
88. Number of complications _____	
89. Other symptoms not included in the complications _____	
90. Treatment of postoperative complications	1.☐ Therapeutic 2.☐ Surgical 3. ☐ Both 99.☐ Unclear/missing
91. In-hospital mortality If yes → 92***a.*** Date of death ___/___/_____ 92***b.*** Cause of the death (based on the pathanatomical conclusion)	0.☐ No 1.☐Yes 1.☐ Complications 2.☐ Other _____

Appendix 3: Data dictionary

Variable	Type	Measure	Definition/Details
Demographic characteristics			
Age	Numeric (continuous)	Years	
Gender	Binary	1=Male 2=Female	
Height	Numeric (continuous)	Cm	
Weight	Numeric (continuous)	Kg	
Marital Status	Nominal	1=single 2=married 3=divorced 4=widowed	
Place of residence (Marz)	Nominal	1=Yerevan 2= Kotayq 3=Tavush 4=Lori 5=Gegharquniq 6=VayotsDzor 7=Syuniq 8=Ararat 9=Armavir 10=Aragatsotn 11=Shirak	The information available on the first page of the medical records

Variable	Type	Measure	Definition/Details
Place of living	Nominal	12=Karabach 1=City 2=Village	
Current smoker Former smoker Presence of allergy	Binary Binary Binary	0=No 1=Yes 0=No 1=Yes 0=No 1=Yes	**The information can be found in anesthesiologists' or surgical (anamnesis vitae) records** (reported by the patient)
Duration of the disease Year of the first symptom First symptom seen by patient	Numeric (continuous) Numeric (continuous) String	Months Year	**The information will be taken from anamnesis morbi** First symptom seen/felt as per patient report Reported by the patient Reported by the patient
Comorbidities			

Variable	Type	Measure	Definition/Details
Diabetes	Binary	0=No 1=Yes	Doctor's report
Hypertension	Binary	0=No 1=Yes	Doctor's report
Preoperative hydronephrosis	Binary	0=No 1=Yes	Revealed either by sonography or CT
Acute preoperative renal failure	Binary	0=No 1=Yes	Doctor's report
Preoperative dialysis	Binary	0=No 1=Yes	Doctor's report
Preoperative chemotherapy	Binary	0=No 1=Yes	Doctor's report
Preoperative radiotherapy	Binary	0=No 1=Yes	Doctor's report
Undergone surgeries in the past	Binary	0=No 1=Yes	Anamnesis vitae of the patient
Diseases in the past	Binary	0=No 1=Yes	Anamnesis vitae of the patient
History of the cerebrovascular disease (stroke, TIA)	Binary	0=No 1=Yes	Anamnesis vitae of the patient
Urological diseases	Binary	0=No	Anamnesis vitae of

Variable	Type	Measure	Definition/Details
		1=Yes	the patient
Gastrointestinal diseases	Binary	0=No 1=Yes	Anamnesis vitae of the patient
Cardiac diseases	Binary	0=No 1=Yes	Anamnesis vitae of the patient
Respiratory diseases	Binary	0=No 1=Yes	Anamnesis vitae of the patient
Other cancer	Binary	0=No 1=Yes	Anamnesis vitae of the patient
Gynecological diseases	Binary	0=No 1=Yes	Anamnesis vitae of the patient
Other diseases	Binary	0=No 1=Yes	Anamnesis vitae of the patient
Preoperative Laboratory Analysis *In the cases of multiple analyses the measurements from the last analysis closest to the surgery will be taken into consideration)*			
Blood group	Nominal	0=I 1=II 2=III 3=IV	Blood analysis
Rhesus factor	Binary	0=Negative 1=Positive	Blood analysis

Variable	**Type**	**Measure**	**Definition/Details**
Hb	Numeric (continuous)	g/L	Blood analysis
Red blood cell count	Numeric (continuous)	$x10^{12}$/L	Blood analysis
White blood cell count	Numeric (continuous)	$x10^{9}$/L	Blood analysis
Platelets count	Numeric (continuous)	$x10^{9}$/L	Blood analysis
Glucose level	Numeric (continuous)	mkm/L	Blood analysis
Total protein level	Numeric (continuous)	mmol/L	Blood analysis
Total bilirubin level	Numeric (continuous)	mkm/L	Blood analysis
Creatinine level	Numeric (continuous)	mkm/L	Blood analysis
Fibrinogen	Numeric (continuous)	mg/100ml	Blood analysis
Serum potassium	Numeric (continuous)	mmol/L	Blood analysis
Serum sodium	Numeric (continuous)	mmol/L	Blood analysis
Hematuria	Binary	0=No 1=Yes	Urine analysis
Piuria	Binary	0=No 1=Yes	Urine analysis
Other changes in urine analysis	Binary	0=No 1=Yes	Urine analysis
Transurethral resection (TUR) in the past	Binary	0=No 1=Yes	Anamnesis vitae of the patient
Preoperative cystoscopy	Binary	0=No 1=Yes	Doctor’s report
Preoperative TUR-	Binary	0=No	Doctor’s report

Variable	Type	Measure	Definition/Details
biopsy of the tumor		1=Yes	
Stage of the cancer		1=pT1N0M0 2=pT2aN0M0 3=pT2bN0M0 4=pT3N0M0 5=pT4N0M0 6=pT2-4N1M0	Pathological examination
Operative Variables			
Type of the urinary diversion	Nominal	1=Continent 2=Conduit	Doctor's report
ASA score	Nominal	1=1 2=2 3=3 4=4 5=5	Anesthesiologist's report
Anesthesia type	Nominal	1=Spinal/epidural 2=General 3=Both	Anesthesiologist's report
Operative time	Numeric (continuous)	Hours	Anesthesiologist's report
Blood loss	Numeric (continuous)	ml	Anesthesiologist's report or doctor's

Variable	Type	Measure	Definition/Details
			report
Intraoperative transfusion (red blood cell) (RBC)	Binary	0=No 1=Yes	Anesthesiologist's report or doctor's report
Intraoperative transfusion (other than RBC)	Binary	0=No 1=Yes	Anesthesiologist's report or doctor's report
The extent of lymphadenectomy	Nominal	1=Limited 2=Standard 3=Till the bifurcation of the aorta 4=Extended	Doctor's report
Number of removed lymph nodes	Numeric (continuous)	Number	Doctor's report
Number of removed positive lymph nodes	Numeric (continuous)	Number	Pathological examination
Invasion of the lymphatic system	Binary	0=No 1=Yes	Pathological examination
Postoperative factors			
Postoperative transfusion (RBC)	Binary	0=No 1=Yes	Anesthesiologist's report or doctor's

Variable	Type	Measure	Definition/Details
			report
Postoperative transfusion (other than RBC)	Binary	0=No 1=Yes	Anesthesiologist's report or doctor's report
Length of the stay at Intensive Care Unit (ICU)	Numeric (continuous)		Anesthesiologist's report
Length of the ureteral catheterization	Numeric (continuous)		Doctor's report
Length of the urethral catheterization	Numeric (continuous)		Doctor's report
Bowel stimulation	Binary	0=No 1=Yes	Doctor's report
Complications after Radical Cystectomy			All complications reported by urologists or by other physicians (if possible supported by sonography, X-Ray or CT)
Any postoperative complication	Binary	0=No 1=Yes	Doctor's report
Postoperative ileus	Binary	0=No	Doctor's report

Variable	Type	Measure	Definition/Details
		1=Yes	
Urinary tract infection	Binary	0=No	Doctor's report
		1=Yes	
Postoperative sepsis	Binary	0=No	Doctor's report
		1=Yes	
Wound infection	Binary	0=No	Doctor's report
		1=Yes	
Postoperative acute	Binary	0=No	Doctor's report
renal failure		1=Yes	
Ureteral obstruction	Binary	0=No	Doctor's report
		1=Yes	
Urinary leak	Binary	0=No	Doctor's report
		1=Yes	
Arrhythmia	Binary	0=No	Doctor's report
		1=Yes	
Postoperative	Binary	0=No	Doctor's report
myocardial infarction		1=Yes	
Deep venous	Binary	0=No	Doctor's report
thrombosis		1=Yes	
Dehiscence	Binary	0=No	Doctor's report
		1=Yes	
Postoperative	Binary	0=No	Doctor's report

Variable	Type	Measure	Definition/Details
hemorrhage		1=Yes	
Other complications	Binary	0=No 1=Yes	Doctor's report
Number of complications	Numeric (continuous)	Number	Doctor's report (the number for each person who has complications
Other symptoms not included in complications	String		Doctor's report
Treatment of postoperative complications	Binary	1=Therapeutic 2=Surgical	Doctor's report
In-hospital mortality	Binary	0=No 1=Yes	Doctor's report

Appendix 4: Details of multiple logistic regression analyses

Model 1	Complic |	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf. Interval]	Log LL test
	_IHid_2 |	2.210884	.7569369	2.32	0.020	1.130164 4.325044	---------
	_IHid_3 |	1.114286	.4761703	0.25	0.800	.482226 2.574794	
	_IHid_4 |	2.47619	1.254092	1.79	0.073	.9176656 6.681649	
Model 2							
	_IHid_2 |	2.504176	.8763616	2.62	0.009	1.261183 4.972232	chi2(4)=15.2
	_IHid_3 |	1.057015	.4608571	0.13	0.899	.4497366 2.484299	p=0.0044
	_IHid_4 |	2.127065	1.110009	1.45	0.148	.7648591 5.915347	(compared
	CAD |	2.718164	.9599756	2.83	0.005	1.360368 5.43119	to Model 1)
Model 3							
	_IHid_2 |	2.090717	.7532761	2.05	0.041	1.031837 4.236229	chi2(4)=24.4
	_IHid_3 |	1.267353	.5701548	0.53	0.598	.5247597 3.060799	p=0.0002
	_IHid_4 |	1.793559	.9561624	1.10	0.273	.6308595 5.099162	(compared
	CAD |	2.4412	.8818815	2.47	0.013	1.202562 4.955634	to Model 2)
	Transfus|	2.40242	.6953771	3.03	0.002	1.362291 4.236703	

Variables in the model: Hid = ID of the hospitals (A,B, C or D), CAD = coronary artery disease,

Transfus = receiving FFP/RBC transfusion

Assessment of the final model fit (Model 3)

1. **Model calibration: Goodness-of-fit test**

. lfit, group(10)

Number of observations = 272

Number of groups = 7

Hosmer-Lemeshow chi2 (5) = 8.69

Prob> chi2 = 0.1220

2. **Model discrimination**

. lroc

Logistic model for Postopcompl

Number of observations = 272

Area under ROC curve = 0.6718

Figure. Area under ROC curve